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Educational multimedia app for dyslexia literacy intervention: a preliminary evaluation

Aznoora Osman[a]*, Wan Ahmad Jaafar Wan Yahaya[b], Aznan Che Ahmad[b]

[a]*Universiti Teknologi MARA Perlis, Arau, 02600, Malaysia*
[b]*Universiti Sains Malaysia, Pulau Pinang,11800, Malaysia*

Abstract

This paper describes the results of a preliminary evaluation of an educational multimedia app containing information and videos of some exemplary techniques in performing reading intervention towards children with dyslexia. The activities encompassed an evaluation with content expert, heuristic evaluation with courseware experts and a pilot study. The evaluation activities revealed some minor errors in the app and were used to make refinement. The pilot study was carried out to evaluate the effects of the app towards learners by employing a pre-test and post-test with a sample of target respondents (*n=30*). They were special education pre-service teachers who were in their fourth semester. Subjects were administered with two instruments about knowledge and self-efficacy belief in dyslexia literacy intervention, before and after using the app. The results revealed mean increase in subjects' knowledge and self-efficacy belief after receiving the treatment.

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Keywords: dyslexia reading intervention, evaluation, Android app;

1. Introduction

A preliminary evaluation of an Android-based educational multimedia app was conducted to evaluate it from experts' perspectives and to test its effect towards the target users. The purpose of the app is to portray some examples of techniques in performing literacy intervention towards children with dyslexia. The app could be used as supplemental material for university course in special education, particularly teaching strategy for children with

* Corresponding author. Tel.: +0-000-000-0000 ; fax: +0-000-000-0000 .
*E-mail address:*aznoora@perlis.uitm.edu.my

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dyslexia. Therefore, the target users are special education pre-service teachers. The app contains background information about each teaching strategy and exemplary videos that demonstrates the technique as employed by actual teachers who specialises in teaching children with dyslexia in learning to read.

Development of the app was underpinned by two theories namely the Cognitive Theory of Multimedia Learning (Mayer, 2009) and the Social Cognitive Theory (Bandura, 1986). The Cognitive Theory of Multimedia Learning (Mayer, 2009) postulates that the human information-processing system contains channels for processing visual/pictorial and auditory/verbal stimulus, in which each channel has restricted capacity for processing, and active learning requires performing suitable cognitive processing during learning. The theory views multimedia learning as a knowledge construction tool, which supports learner to actively make sense of the presented information, rather than as a passive receiver. The Social Cognitive Theory (Bandura, 1986) suggests that people can learn new information or behaviour by observing others. This process is also known as observational learning. In this view, observers are more likely to learn from a model that they perceived as having similar characteristics or as someone superior. By observation, the learners can acquire knowledge in the demonstrated behaviour without practising it. Therefore, the learners may in the future perform the behaviour when situation permits.

The development process was implemented according to the model of multimedia design and development (Alessi and Trolip, 2001). The model was chosen because it offers flexibility in designing instructions according to the needs and characteristics of the multimedia learning software. The model encapsulates the necessary steps in executing the planning, design and development phase. It incorporates three attributes which are standards, on-going evaluation and project management in the planning, design and development phases. Evaluation of the app was done at the end of development phase. The following sections contain some literatures pertaining to the study.

1.1. Dyslexia and reading intervention strategies

Dyslexia is a specific language disorder that causes problem in reading, writing and speaking (Richardson, 1992). It has been described as a specific learning disability that is neurobiological in origin and is characterized by poor word recognition, spelling and decoding abilities despite having higher cognitive abilities and receiving effective classroom experience (Reid, Shaywitz, & Shaywitz, 2003). Dyslexia is defined by the World Federation of Neurologist as ‘a disorder in children who, despite conventional classroom experience, fail to attain the language skills of reading, writing, and spelling commensurate with their intellectual abilities’ (Gomez, 2004). Strong evidence shows that children with dyslexia continue to experience reading problems into adolescence and adulthood (Shaywitz, et al., 1999; Shaywitz, et al., 2003).

Therefore, it is paramount to help dyslexic children to master the reading skills because if left untreated, they will develop low self-esteem and poor confidence (Abdullah, 2004). Furthermore, without effective intervention, a person could develop emotional problem because of inferiority and frustration (Wong, 2009). Spector (1995) in Muter (2004) has suggested early intervention program to include training in phonological awareness, that is by practising the sound of words, segmenting and blending sound in words and training phonics (letter-sound relationships). Echoing this, Thompson (2010) recommended that reading intervention for children with dyslexia should not only be phonologically-based, but incorporates the multisensory technique, involving complete utilisation of the children's visual, auditory and kinaesthetic sensory components to enhance memory and learning..

1.2. Multimedia learning for teacher education

Past research has shown the effectiveness of multimedia learning application in teacher education, for instance Levin and Matthews (1997) revealed multimedia has positively influenced the awareness, knowledge and attitudes of pre-service teachers toward gender-equity issues in elementary classrooms. Meanwhile, multimedia courseware embedded with exemplary videos and animations were able to promote positive attitudes towards learning and enhance motivation perceptions among learners, as compared to learners who learned without exemplars (Moreno & Ortegano-Layne, 2008). Furthermore, Goldman and Torrisi-Steele (2009) described a CD-ROM based courseware about human relationship education, which was designed as a teaching tool to replace lectures and tutorials, and as a revision tool for primary pre-service teachers. It was found that the courseware was able to enhance the pre-service teachers' learning about key concepts of the topic, and learners favoured the courseware since it allowed them to

study at own pace. In addition, Fitzgerald, et al. (2011) concluded that multimedia cases helped bridge the gap between theory of teacher education and practice, thus enhancing the pre-service teachers' knowledge and skills in teaching students with emotional/behavioural disorders.

Considering the benefits of multimedia learning application towards learners, it was chosen as the technology to be utilised in developing supplemental material about dyslexia for pre-service teachers. In line with the concept of observational learning and modeling in Social Cognitive Theory, videos was chosen as modeling tool to be embedded into the multimedia learning application since it has the capability to portray real examples of behavior while it is performed in authentic setting. The video would demonstrate some strategies in employing multisensory techniques and phonics when teaching dyslexic children to read.

2. Application of principles into the user interface design

The Principles of Multimedia Design (Mayer, 2009; Clark and Mayer, 2011) and the Usability Framework for m-Learning (Fetaji and Fetaji, 2011) were used as guidelines in designing the user interface and navigation. The principles of Multimedia Design (Mayer, 2009) were derived from the Cognitive Theory of Multimedia Learning. It supports instructional designers in the design of multimedia instruction that manage the cognitive load of the learners. The purpose of the principles are to ensure the multimedia learning environment is designed in such a way that it will promote deep and meaningful learning by supporting cognitive processes such as reducing extraneous processing, managing essential processing, and fostering generative processing. The extraneous processing involves processing of unrelated material during learning which is caused by poor instructional design. The essential processing is the processing of the essential material in working memory, while the generative processing aims to promote deeper understanding where learners make sense of the presented material.

One of the principles in managing essential processing is the segmenting principle. Mayer (2009) suggested that multimedia message be divided into smaller more manageable chunks that keep pace with the user rather than as a large continuous piece. When an essential material is too complex, it will overload the working memory of the learners, making it impossible to comprehend at once. Mayer (2009) asserted that in this situation, learner might be able to select only a few portions of the lesson, but unable to gain deep understanding. Ideally, with smaller segments that allow user control, learners could learn each at their own pace.

The segmenting principle was applied to the videos embedded in the app, in which a pre-recorded full-length video was divided into smaller but meaningful segments. Each video segment is accompanied with a player that consists of the Play, Pause, Stop and Slider buttons. This could allow freedom for learners to play, pause and stop at any time and watch the videos from any section that they prefer. Besides that, the background information for each intervention technique which mainly contained texts was also divided into smaller segments to support user-paced learning.

The intervention technique demonstrated in the app was made up of three steps, which were identifying letter-shape, identifying letter-sound and pronouncing syllables. For each step, its background information and video segments were presented in three tabbed screens namely Introduction, Preparation and Technique. The background information was described in the Introduction and Preparation tabs, while the video segments can be found under Technique tab. Figure 1 depicts the screen of pronouncing syllables.

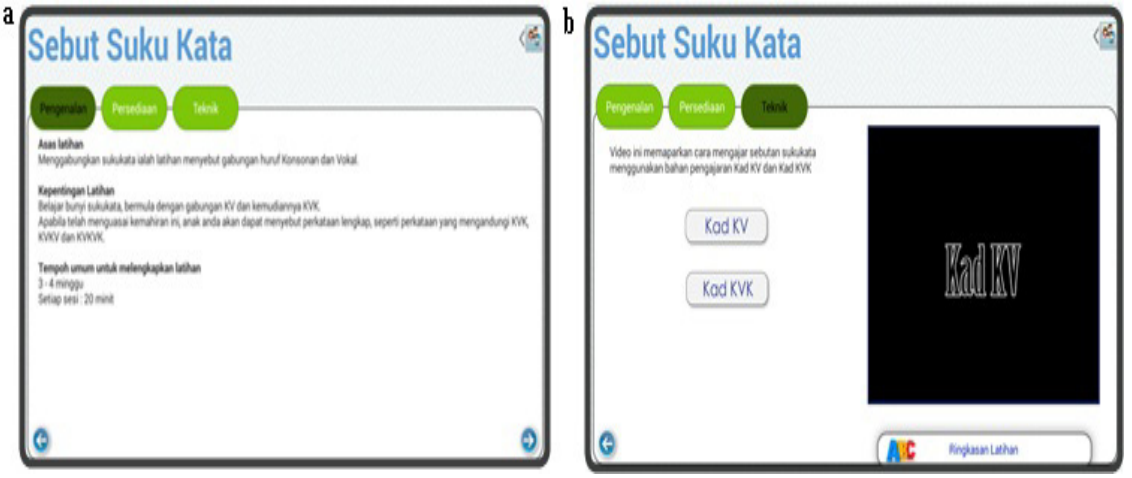

Fig. 1. (a) Pronouncing Syllables - Introduction; (b) Pronouncing Syllables - Technique

3. Evaluation process

The preliminary evaluation consisted of two activities which were evaluation by experts, followed by a pilot study with a small group of subjects. The evaluation by experts was crucial because it could elicit errors in the user interface and contents of the learning app. Thus, refinement could be made before it was used in a pilot study. The following sub-section provides description of the activities.

3.1. Evaluation by experts

The expert evaluation entailed quality review by a subject matter expert and multimedia experts. The subject matter expert was a senior lecturer in special education who has a Ph.D qualification and more than ten years of experience in the field. As such, it was deemed sufficient to perform initial evaluation with only one subject-matter expert. The expert evaluated the app contents using a courseware evaluation form which encompasses dimensions such as instructional design, learning contents, user control and technical issues. Among the items included for evaluation were the suitability of teaching strategy and method employed with the target users, sufficiency of interactivity in navigation, spelling and word structures, and suitability of the interface design with the users. Based on the suggestions made by the expert, minor corrections were made to the instructional design and learning contents to make it more comprehensible by the learners. According to the expert, the details for every intervention technique should be provided in succinct explanations. This is to avoid boredom among learners when they are forced to read long sentences in a small screen such as tablet. Therefore, certain sentences which were considered too long by the expert were reconstructed into concise statements. Additionally, the expert commented there should be a sentence to clearly state that the app portrays only some examples of reading intervention technique. This was a way to inform learners that many other possible techniques exist, which can be employed by teachers. In the area of interactivity and navigation, the expert recommended adding Back button on every screen to return to the previous page of the lesson. This would provide opportunity for learners to revisit preceding lesson and adequately learn basic but necessary knowledge before exploring more advanced lessons.

The multimedia experts evaluated the usability of the application using a heuristic evaluation form which was adapted from Nielsen's Heuristic (Nielsen, 1994). It is a type of inspection that enables the experts to compare the learning application against accepted usability principles. Therefore, usability problems on the user interface could be identified. Two senior lecturers in the field of multimedia, who have approximately eight years of teaching experience in the area were selected to conduct the heuristic evaluation. The experts were required to use the app from the beginning and inspect every screen thoroughly. They listed all usability problems that were detected into

the evaluation form and described how the problems violated the heuristics. The recommendations made by the experts were taken into considerations. Thus, few elements on the user interface were modified, such as adding Home button on every screen to make it easier to return to the main screen. This flexibility in navigation could allow users to revisit the beginning of the lesson and jump to any screen afterwards. By performing the simple modification towards the navigation, it would enable complete user control and freedom as recommended in the usability heuristics. Beside that, every link for the videos was also added with label to indicate its duration. It was deemed important because it will enhance the visibility of the system status, which is also outlined by the Usability Guidelines for m-Learning (Fetaji & Fetaji, 2011). Initially, each video segment would be played within its pre-defined area on the screen. The experts commented that it was quite small; hence modification towards the video controller was made so that it could be run in full screen.

3.2. Pilot study

Upon completion of refinement towards the app, a pilot study was carried out with a small group of learners who were administered with the pre-test, treatment and post-test. 30 university students who were undertaking a degree in special education participated in the study. They were in Semester 4 and have undertaken an introductory course about learning difficulties. They will not be participating in the actual data collection. The purpose of the pilot study was to evaluate the effects of the learning app on the knowledge and self-efficacy belief of the subjects toward dyslexia literacy intervention. It also serves other purposes as outlined by Chua (2012), such as to ensure that the research procedures can be run smoothly in actual data collection, to identify any problem that might arise during actual study, and to make suggestions for improvement of the actual study. The process enabled the researcher to observe how learners use the application, the problems that they encountered while using the app, the time taken to administer every instrument and the procedure that could be improved as a preparation for the actual study.

The learning app has been pre-installed into each tablet. As such, there is no need for internet connection to download and install it during the pilot study session. Errors and problems with the application, especially the videos were also examined. It was observed that some participants encountered problem in loading certain videos after touching the links. Nevertheless, after performing inspection on the tablets that they were using, this was mainly caused by the processing capability of some tablets. The issue was recorded and resolved by ensuring the cache memory of each tablet be cleared prior to treatment session.

During the pilot study, the subjects were required to answer two instruments pertaining to their knowledge in dyslexia reading intervention, and self-efficacy in implementing reading intervention. They were administered with these instruments during pre-test and post-test. The instruments were developed by the researchers of the study in order to ensure that it measures only topics that have been covered in the learning app. The reliability tests for both instruments were conducted earlier; by employing the internal consistency procedure using Cronbach Alpha. The instrument to measure knowledge, which is Scale of Knowledge in Dyslexia Literacy Intervention, yielded an internal consistency of 0.936. It measures the subjects' knowledge in the learning difficulties and socio-emotional problems usually faced by children with dyslexia, as well as the knowledge in implementing literacy intervention towards children with dyslexia. It contains 30 statements and is divided into three sections, which are Reading Difficulties, Socio-Emotional Problem and Literacy Intervention.

The instrument to measure self-efficacy belief, which is Self-Efficacy Belief in Implementing Dyslexia Literacy Intervention, yielded an internal consistency of 0.935. The instrument contains 12 statements that measure the subjects' self-efficacy belief in implementing literacy intervention towards children with dyslexia. The statements are concerned with identifying the specific reading difficulties, preparing teaching aid and implementing the literacy intervention according to the correct strategies. Both Cronbach Alpha values were considered within excellent range, as described by George and Mallery (2003).

The study was designed by conducting a pre-test, followed by treatment through the app. The subjects were given 60 minutes to use the app. They were also provided with a user manual and were shown a demonstration about using the app. It was observed that the subjects could familiarize themselves with the app fairly quickly and used it smoothly. After the treatment, the subjects were administered with the same instruments again, but with items restructured. The result of the pilot study revealed that there was an increase in the mean score for knowledge

and self-efficacy belief among the subjects after receiving the treatment via the learning app. Table 1 and Table 2 describe the results for knowledge and self-efficacy belief during pre-test and post-test.

Table 1. Result of Knowledge test

	Pre-test	Post-test
n	30	30
Mean score	126.57	132.93
Standard deviation	10.71	8.74

Table 2. Result of Self-efficacy Belief test

	Pre-test	Post-test
n	30	30
Mean score	45.13	50.73
Standard deviation	4.62	4.22

4. Conclusion

The preliminary evaluation which consisted of evaluations by experts in subject-matter and in multimedia has enlightened the researchers about some usability and contents flaws. Among the substantial ones found in the user interface were the navigation and content structures. The recommendations by the experts were used as guidelines in the process of making improvement towards the learning app. It was an essential step before employing the app as a treatment in a pilot study to test its effects towards learners. The outcome of the pilot study indicated that the app has successfully enhanced the knowledge and self-efficacy belief in dyslexia literacy intervention among the subjects. The pilot study provided a window of opportunity to test the research procedures and the effectiveness of the app on a small scale. In order to obtain a more reliable result concerning the effects of the app towards learners, the study will be extended with a larger number of subjects during actual data collection phase.

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